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Effects of Different Wastewater Treatment Processes on Occurrence and Prevalence of Antibiotic Resistant Bacteria and Their Resistance Genes

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Abstract

This study aimed to explore the difference between hospital and municipal wastewater treatment processes regarding the reduction of antibiotic-resistant bacteria (ARB) and antibiotic resistant genes (ARGs). Samples were collected from raw and final effluent of four different wastewater treatment plants (WWTPs). ARB were evaluated by modified HPC method. Extraction and purification of DNA from the samples were conducted by Freeze-Thaw and DNA extraction kit. Real-time PCR (qPCR) was utilized to obtain the quantity of *Sul*1 and *Erm*B genes in the samples. For standard control in qPCR, was used plasmid containing each gene sequence. The average ARB concentration in the raw wastewater and effluent was 1.03×10^{7}-6.63×10^{7} CFU/100mL. Quantitative range of the *Sul*1 and *Erm*B genes were obtained as 0-8.3×10^{10} Copies/100 mL and 9.29×10^{5}- 9.64×10^{9} Copies/100 mL, respectively. The results show that urban wastewaters play a more significant role than hospital wastewaters in the emission of sulfonamides and erythromycin-resistant bacteria and genes to the environment. Findings revealed that conventional wastewater treatment plants cannot be regarded as reliable barriers for the control of these agents.

Keywords: Antibiotic-resistant bacteria, ARGs,Hospital wastewater,Urban wastewater, Real-time PCR, *Sul*1, *Erm*B

1 Introduction

Increasing concerns have been reported about the negative impacts of antibiotic residuals on the environment (1-3). The major representation of this problem is the development of antibiotic resistance (4-6). Antibiotic resistance has been reported all around the world. The WHO has mentioned antibiotic resistance as one of the three major problems of the 21st century (4, 7). This resistance has been observed across a wide variety of environments such as water, soil, air, and wastewater (8, 9). Antibiotic resistance can be developed by different ways, including the direct entrance of resistant bacteria from therapeutic settings or the antibiotic residual pressure in environmental resources (10). The developed resistance can cause changes in the natural ecosystems. Urban and hospital wastewaters are the most important sources that release these contaminants to the environment (4). Wastewater treatment plants are one of the most important and recent obstacles in the emission of resistant bacteria and genetic elements to the environment (11). Researchers have not reached a consensus regarding the effects of WWTPs yet. Some have reported the reducing effect of these plants. Others, however, have mentioned the increasing effects of treatment plants on the emission of agents that can develop antibiotic resistance. A number of studies have regarded the effect of urban WWTPs, and other researchers believe the hospital WWTPs to be more efficient. Research shows that the destiny of various antibiotic resistance factors in the environment is contingent upon different factors, including the type of treatment processes, procedure of operation, wastewater

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